



Dam Safety: Open Channel Spillways (Earth and Rock)

Open channels are often used as the emergency spillway and sometimes as the principal spillway for dams. A principal spillway is used to pass normal inflows, and an emergency spillway is designed to operate only during large flood events, usually after the capacity of the principal spillway has been exceeded. For dams with pipe conduit principal spillways, an open channel emergency spillway is almost always required as a backup in case the pipe becomes clogged. Open channels are usually located in natural ground adjacent to the dam and can be vegetated, rock-lined, or cut in rock.

Design

Flow through an emergency spillway does not necessarily indicate a problem with the dam, but high velocity flows and/or frequent operation can cause severe erosion and result in a permanently lowered lake level if not repaired. Proper design of an open channel spillway will include provisions for minimizing any potential erosion. One way to minimize erosion is to design a flatter channel slope to reduce the velocity of the flow. Earthen channels can be protected by a good grass cover, an appropriately designed rock cover, concrete or various types of erosion control matting. Rock-lined channels must have adequately sized riprap to resist displacement and contain an appropriate geotextile fabric or granular filter beneath the rock. Guide berms are often required to divert flow through open channels away from the dam to prevent erosion of the embankment fill. If an open channel is used for a principal spillway, it must be rock-lined or cut in rock due to more frequent or constant flows.

Maintenance

Maintenance should include, but not be limited to, the following items:

- **Grass-covered channels should be mowed at least twice per year to maintain a good**

grass cover and to prevent trees, brush and weeds from becoming established. Poor vegetal cover can result in extensive and rapid erosion when the spillway flows. Repairs can be costly. Reseeding and fertilization may be necessary to maintain a vigorous growth of grass. See Fact Sheet 03-12 for additional information on grass cover.

- **Trees and brush must be removed from the channel.** Tree and brush growth reduces the discharge capacity of the spillway channel. This increases the lake level during large storm events which can lead to overtopping and failure of the dam.
- **Erosion in the channel must be repaired quickly after it occurs.** Erosion can be expected in the spillway channel during high flows, and can also occur as a result of rainfall and runoff, especially in areas of poor grass cover. Terraces or drainage channels may be necessary in large spillway channels where large amounts of rainfall and runoff may concentrate and have high velocities. Erosion of the side slopes may deposit material in the spillway channel, especially where the side slopes meet the channel bottom. In small spillways, this can significantly reduce the discharge capacity. This condition often occurs immediately after construction before vegetation becomes established. In these cases, it may be necessary to reshape the channel to provide the necessary capacity.
- **All obstructions should be kept out of the channel.** Open channel spillways often are used for purposes other than passage of flood flows. Among these uses are reservoir access, parking lots, boat ramps, boat storage, pasture and cropland. Permanent structures (buildings, fences, etc.) should not be constructed in these spillways. Fences, bridges or other such structures should not be allowed in any open-cut spillway. If these structures are absolutely

necessary, they should only be constructed far enough downstream from the control section so that they do not interfere with the flow. Construction anywhere else can cause blockage of the spillway and overtopping of the dam. Construction of any structures in or across the channel requires prior approval from the Division of Water.

- **Weathering of rock channels can be a serious problem and is primarily due to freeze/thaw action.** Deterioration due to the effects of sun, wind, rain, chemical action and tree root growth also occurs. Weathered rock is susceptible to erosion and displacement during high flows.

Monitoring

Open channel spillways should be monitored for erosion, poor vegetal cover, growth of trees and brush, obstructions, and weathering and displacement of rock. Monitoring should take place on a regular basis and after large flood events. It is important to keep written records of observations. Photographs provide invaluable records of changing conditions. All records should be kept in the operation, maintenance, and inspection manual for the dam.

Any questions, comments, concerns, or fact sheet requests should be directed to the Division of Water at the following address:

Indiana Department of Natural Resources
Division of Water
402 West Washington Street
Indianapolis, Indiana 46204
(317) 232-4160 (Voice) (317) 233-4576 (Fax)
<http://www.in.gov/dnr/water>